

# A global model of recovery and rebalancing

Revised April 2012

**Rudiger von Arnim** *Corresponding author*

Assistant Professor of Economics, University of Utah.

Dept. of Econ., 260 Central Campus Drive, OSH #339, Salt Lake City, UT 84112, USA

E-mail [rudiger.vonarnim@economics.utah.edu](mailto:rudiger.vonarnim@economics.utah.edu), Tel +1 (801) 587 8327, Fax +1 (801) 585 5649

**Steve Bannister**

PhD Candidate, University of Utah.

**Nathan Perry**

Assistant Professor of Economics, Colorado Mesa University

April 5, 2012

## Abstract

This paper presents an investigation of global recovery from the great recession and rebalancing of global external imbalances, using a global model of sixteen countries and composite regions. The model applies to the short run, and only to the real side. Key features are demand-driven output determination, pro-cyclical aggregate labor productivity, imperfect competition in product markets and simple bargaining in non-clearing labor markets, which together determine the functional distribution of income. Trade is modeled in a bilateral import matrix; particular attention is paid to international adjustment. Simulation results suggest that early exit from fiscal support threatens a fragile recovery. Further, domestic demand expansion and revaluation in real terms in surplus countries are necessary for rebalancing, and a variety of measures can be employed to achieve these goals.

**Key words:** Global imbalances, Great recession, global model

**JEL codes:** E12, F32, F42, F47

## Acknowledgements

Financial support from the ILO's International Institute of Labor Studies is gratefully acknowledged. We thank two anonymous referees and R. Torres as well as M. Charpe and E. Ernst for helpful comments. All remaining errors are ours.

## 1. Introduction

The *Great Recession*, emanating from US real estate and financial markets, has cost a multitude of jobs all around the world. The financial panic of 2008 and 2009 destroyed vast amounts of wealth, and threatens to solidify a trend of increasing inequality within countries. Much ink has been spilled on the various factors feeding into the crisis.

High on the list is lax financial regulation. Furthermore, after the new economy bubble burst, longer term global interest rates remained suppressed due to policy driven purchases of developed country assets by both Asian merchandise and Middle Eastern energy exporters. The combination of these

factors led to a lending frenzy. Wall Street recycled the world's surpluses to US households via subprime loans, and to Eastern Europe as well as the Southern Eurozone, via German, French and Austrian banks. In the process, bankers and shadow bankers everywhere also lent to each other, to lever up. Quite classically, when the asset side of their balance sheets deteriorated, or they couldn't roll over their liabilities, or both, banks faced a maturity, a currency or a maturity and a currency mismatch.

In this view, external imbalances are an important feature of the crisis, even if certainly not the sole driver. Since neither the US's private nor Greece's public sector are willing or able to take on further debt, reduction of imbalances must as well be a feature of a sustainable recovery.<sup>1</sup> That is clearly in deficit countries' interest: The lower external deficit implies stabilization of foreign debt; if the reduction can be achieved without a recession, it implies as well decreases in unemployment. Surplus countries are, unsurprisingly, less enthusiastic. They could, however, benefit from a reduction in global imbalances if higher domestic demand replaces external demand. As such, rebalancing should aid recovery, in the sense that it is more than a redistribution of global demand. In this paper, we use a Keynesian multi-region model to investigate whether commonly suggested routes to rebalancing and recovery can be successful. In the following sections we present a global data set, the model and simulations.

## 2. A data set of the (real) world economy

The global data set constructed for this paper covers a large share of the world's national economies—one hundred and sixty countries. Their relative size and their geographical trade relationships play a crucial role. The model dataset is aggregated into sixteen countries and regions; the countries are US, Japan, Canada, and the BRICS (Brazil, Russia, India, China and South Africa),<sup>2</sup> the regions Africa, Asia, Eurozone, the rest of Europe, and Latin America and the Caribbean.<sup>3</sup> Countries with more than half of their exports concentrated in petroleum and related products as well as natural gas are grouped together. Asia and the Eurozone are further disaggregated into surplus and deficit regions. Especially the latter has for a while been largely in external balance, but, as has become abundantly clear, Eurozone internal imbalances are sizable, and do matter.

The national accounts data is presented in Table 1. The base year of the national accounts data is 2008; for these and all other data see the appendix for further details on sources and procedures. The table reports GDP and related shares for aggregates and the sixteen model countries and regions. The developed world consists of the US, Europe, Japan and Canada. In the lower part, Europe disaggregates into three regions, Eurozone surplus countries, Eurozone deficit countries, and the rest of Europe. The next bloc shows developing countries. The last item shows a composite region of energy exporters, which are heterogeneous geographically and on an income basis, but have in common high ratios of energy to total exports. The fifth, sixth and seventh column report private, public and external balances

<sup>1</sup> We will not review the literature on the causes of global imbalances. The most compelling arguments have emphasized the role of US debt-driven private demand. See Barbosa-Filho, Rada, Taylor, and Zamperelli (2008), Papadimitriou, Chilcote and Zezza (2006). Von Arnim (2009) discusses these and other main hypotheses.

<sup>2</sup> The original BRICS do not include South Africa. Since South Africa is so crucial an economy on the African continent, it is included here individually and added to the "BRIC."

<sup>3</sup> The composite developing regions (Africa, Asia, Latin America) exclude "their" BRICS.

relative to GDP. Private plus public minus external balance adds to zero; if not, it is due to rounding. For the World in the first row, the “external deficit” of -2.6 per cent is the cumulative external balance of all deficit countries relative to World GDP, obviously mirrored by the remaining countries’s cumulative surplus.<sup>4</sup> It gives an indication of the infamous global imbalances. The remaining columns show savings, taxes and export revenue relative to GDP, as well as exports relative to global exports. A few quick insights can be gleaned from this data. World GDP (in the model aggregation) adds to roughly 60trn US dollars, two thirds of which stem from developed countries, another sixteen per cent from the BRICS, five from energy exporters and the remaining thirteen from developing countries. The US has overall a low savings rate; Japan, energy exporters, the RIC of the BRICS and Eurozone surplus countries feature high savings rates. High private demand in the US finds its expression in a high external deficit, energy and manufacturing exporters feature the matching surpluses.

Labor market data is summarized by the unemployment rate. It is based on population, labor force, employment and unemployment data from national statistics offices, regional development banks as well as ILO’s Laborsta and Eapep databases. Reported unemployment rates are used where available, estimates based on the highest quality underlying data where not. All unemployment rates are for 2008, as is the rest of the data. US unemployment, for example, averaged below six per cent for the year of 2008. Of course, the rate has since risen to about ten per cent. Is our data out of date? It is always difficult to compile large *and* up to date data sets. Results can still be interpreted with current conditions in mind since what matters most are the relative size of the economies, their external economic relationships, as well as the direction of change of, for example, unemployment rates.

The bilateral trade data is presented in Table 2. The table shows levels of country-by-country (region-by-region) exports and imports in billions of 2008 US dollars. Read along rows, the table reports exports; read along columns, it reports imports. Rows 17 through 19 indicate export, imports and the difference between them—since we are abstracting from income payments and transfer, this is equal to the current account. The lower part of the table reports bilateral import propensities in percentage points, so that the column sums at the bottom show country and region aggregate import propensities. In levels, the largest economies show the largest volumes of exports and imports. Only the US and China are large enough to show large trade volumes as individual countries; otherwise, composite regions weigh heavily, and regional links are apparent. In shares, however, the regional links become still more important. The strongest trade links appear within the three European regions (plus Russia), within the five Asian regions (India, China, Japan, plus rest of Asia surplus and deficit regions), within the Americas (Canada, US, Latin America and Carribean plus Brazil) as well as from the world to energy exporters. Africa—both South Africa and the rest of Africa, excluding energy exporters—show the least integration with the world economy, though Africa’s highest degree of integration is apparent vis-à-vis the

<sup>4</sup> Due to reporting problems, real world data often shows that global exports are *not* equal global imports. The trade data in the IMF trade matrix has been adjusted to correct this, which implies that the sum of all countries’ external positions is equal to zero. The statistic here—the sum of external deficits of all countries that have an external deficit—is included to provide a measure of global imbalances.

European regions. As will be seen in the next section, the transmission of shocks throughout the world economy is crucially tied to this regionally dominated trade structure.

Next, we discuss the model to which this dataset is applied.

### 3. A global model of demand and distributive conflict

The model falls within the general category of empirical economy-wide models, often labeled, slightly misleadingly, Computable General Equilibrium (CGE) models.<sup>5</sup> Its structure fits broadly in the tradition of Rowthorn (1982), Dutt (1984), and Taylor (1985), even though the rate of accumulation is exogenous. Of course, one might desire an investment function. Empirically, however, they tend to be unreliable, and elasticities are sparse for the large set of countries put together here. An exogenous rate of accumulation renders domestic demand *always wage-led*, since an increase in real wages (not matched by productivity increases) feeds into consumption, but does not reduce capital accumulation. If, on the other hand, investment were sensitive to changes in profitability—or, equivalently, real unit labor costs—then a strong decrease in investment compared to the increase in consumption could render demand profit-led. However, as households in the North are struggling to reduce debt to income ratios, and households in the South (and East) have huge potential for consumption catch up, it might indeed be reasonable to assume demand to be wage led.

Product and labor markets are covered in simple but comprehensive fashion. The size of the mark-up depends on the degree of competition in product markets. High mark-ups, of course, imply high profit shares. Demand is a function of expenditure levels, the multiplier and the real exchange rate. The multiplier increases with redistribution towards wage earners, due to their lower propensity to save. It changes as well with prices: All else equal, higher domestic prices imply a real appreciation and a higher import share—which lowers the multiplier. A real appreciation has as well a negative impact on the level of external demand. In that fashion, expenditures, prices and distribution all affect value added. Households, in turn, earn labor and capital income—meaning there are really two, namely owners and employees. They bargain in labor markets over nominal wages, the single argument being the rate of employment in a simple wage curve. Further, labor productivity depends on demand conditions, due to labor hoarding as well as overhead labor. The ratio of the real wage and labor productivity is equal to real unit labor cost. The higher the worker's real wage relative to her productivity, the higher is the wage share.

In the following paragraphs, we present first a one-country version, then discuss dynamic stability in two dimensions, and briefly consider issues pertaining to the multi-region model.

#### **A one-country version**

Let us begin here with the underlying accounting. First,

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<sup>5</sup> A CGE model is based on a Social Accounting Matrix (SAM), which depicts detailed data on relations of production and distribution between main socio-economic agents in an economy. The model adds behavioral relationships to the accounting; econometric evidence is applied to calibrate relevant parameters. The complete model can then be used to calculate counterfactuals in response to assumed shocks and policies. For standard discussions of the methodology, the pioneering contributions by Taylor (1979, 1983), as well as Pyatt (1988) or Robinson (2003). A previous discussion of this paper is available as von Arnim (2010).

$$QY = wL + rPK$$

is GDP at factor cost.  $Y$  is real GDP,  $Q$  the GDP deflator.  $w$  is the nominal wage rate and  $L$  an index of (hourly) employment, so that  $wL$  is the wage bill. Similarly,  $r$  is the rate of profit, and  $PK$  the stock of capital  $K$  valued at the supply price  $P$ . It follows that

$$1 = \frac{wL}{QY} + \frac{rPK}{QY} = \psi + \pi,$$

where  $\psi$  is wage and  $\pi$  profit share. Without intermediates, adding import to factor costs gives total cost, which is equal to total supply:

$$PX = wL + rPK + eP_f M = P(C + I + G + M_f),$$

where the subscript  $f$  indicates the foreign country, and real exports  $M_f$  are the imports of the foreign country from this economy, valued at the domestic supply price  $P$ . Household income, in turn,

$$QY = PC + (s + t)QY$$

is divided between consumption  $PC$  and taxes and savings,  $(s + t)QY$ .

Government saving is

$$S_G = tQY - PG,$$

where  $t$  is the uniform net tax rate and  $G$  are real government expenditures.  $S_G$ , of course, tends to be negative. Foreign saving is

$$S_f = eP_f M - PM_f = -CA$$

the negative of the current account.  $e$  is the nominal exchange rate, quoted as the domestic currency price of one unit of foreign currency. Private saving  $sQY$  is the sum of savings out of wage and profit income,  $sQY = s_\pi rPK + s_\psi wL$ , so that the aggregate propensity to save can be written as a negative function of the wage share,

$$s = s_\pi - (s_\pi - s_\psi)\psi.$$

The price of a unit of GDP,  $Q$ , is the mark-up price on nominal unit labor costs. Writing average labor productivity  $\xi = Y/L$ , nominal unit labor costs are  $wL/Y = w/\xi$ , the mark-up price follows as

$$Q = (1 + \tau) \frac{w}{\xi},$$

where  $\tau$  is the mark-up rate, and  $1 + \tau = 1/(1 - \pi)$ . The mark-up price goes back to Kalecki; see Lee (1998), Part III, for an extensive survey. The supply price  $P$  follows from cost accounting. Imports can be written as  $M = mX$ , and since  $Y = (1 - m)X$ , the supply price can be expressed as the weighted average of the price of domestic content and import prices,

$$P = (1 - m)Q + mP_f.$$

$P$  as a cost price is anchored by factor prices. Pass-through of exchange rate shocks or foreign inflation is limited, but plays an important role in determining domestic price changes and therewith real exchange rate changes. Next, the *nominal* wage rate  $w$  is determined by a simple wage curve, according to which a higher employment rate leads to higher bargained wage levels,

$$w = w_0 \left[ \frac{L}{N} \right]^{w_1},$$

where  $w_0$  is an ‘intercept,’  $w_1$  the bargaining elasticity, and  $L/N$  the employment rate. See Blanchflower and Oswald (1990, 1994), as well as Carlin and Soskice (1990).<sup>6</sup> The profit rate  $r$  follows as a positive function of the profit share, the rate of capacity utilization  $u = Y/K$  and the price ratio  $Q/P$ ,

$$r = \frac{r_{PK}}{QY} \frac{QY}{PK} = \pi u \frac{Q}{P}.$$

Let us now consider demand, savings, productivity and labor demand in turn. Total supply is  $X = C + I + G + M_f$ . With  $C = (1 - s - t)QY/P$  and  $Y = (1 - m)X$ , GDP is  $Y = k(I + G + M_f)$ , with the multiplier

$$k = \frac{1-m}{1-(1-m)(1-s-t)Q/P}.$$

Real imports  $M = mX$  are a function of the real exchange rate  $\rho = eP_f/P$  and production  $X$ ,

$$m = m_0 \rho^{-\alpha} X^{\beta-1},$$

where  $m_0$  is an ‘intercept,’ and  $\alpha$  and  $\beta$  are price and income elasticity of import demand.

In the short run, labor productivity  $\xi$  increases in the rate of capacity utilization,

$$\xi = \xi_0 u^{\xi_1},$$

due to labor hoarding as well as overhead labor. Labor hoarding refers to the fact that firms retain skilled employees throughout a downturn because retraining new employees in the upturn would be costlier; overhead labor refers to the fact that firms usually have some back-office and managerial staff not easily made expendable. With GDP  $Y$  and productivity  $\xi$  determined, labor demand follows as

$$L = \frac{Y}{\xi}.$$

This labor demand function is consistent with fixed proportions technology and varying unit labor requirements, and implies Okun’s Law, since pro-cyclical labor productivity dampens the employment effect of a demand expansion. Now, we can investigate dynamic stability in two dimensions.

### **Dynamic stability**

A dynamic version of the model is presented here in the rate of capacity utilization and the share of labor income. We present this stylized model in order to emphasize key macroeconomic adjustment mechanisms. How does it relate to the version above? The dynamic version describes one country (instead of many regions) with a *real* wage curve (instead of a *nominal* wage curve and a full price system)<sup>7</sup> and a net export function that responds to real unit labor costs (instead of import functions responsive to real exchange rate changes). The advantage is that we can consider stability in two

<sup>6</sup> Workers (or unions) bargain for *nominal* rather than *real* wages—they can only influence the former, even if they have the latter in mind: “[A...] fundamental objection [... to classical theory of employment] flows from our disputing the assumption that the general level of *real* wages is directly determined by the character of the wage bargain.” (my emphasis, see Keynes 1936, chapter 2, p.13.) A standard specification used today features the nominal wage deflated by the *expected* price level as a function of the employment rate, see Carlin and Soskice (1990), chapter 6 as well as 17 and references therein. Since the model applied here abstracts from expectations, we specify the *nominal wage as a function of the employment rate*. Together with cost-driven and thus “anchored” output prices, this implies an upward sloping bargained real wage curve in real wage-employment space; consistent with Fig.6.1 on page 139 of Carlin and Soskice (1990). Similarly, Flaschel (2009) emphasizes the theoretical and empirical relevance of specifying separate wage and price functions, which will then combine to determine the real wage.

<sup>7</sup> See as well footnote 6 above: The purpose of assuming a *real* wage curve in this section is to reduce dimensionality. The core causal links remain the same.

dimensions, and focus on what matters. First, the dynamic goods market specification is a simple excess demand function. Second, inflation is fundamentally driven by conflict, which is here expressed in terms of the functional distribution of income. With simple adaptive dynamics (and endogenous equilibrium values for the rate of utilization and the labor share), the time paths of the dynamic version will converge to the comparative static equilibria, bar the simplifications, of course. Hence, the principal structure of the two models is the same.

Let us first consider a closed economy. The investment rate is assumed exogenous, but the rate of accumulation permitted by savings depends on utilization and distribution,

$$\frac{I}{K} = g^I, \text{ and}$$

$$\frac{S}{K} = (s_\pi - (s_\pi - s_\psi)\psi)u.$$

Dynamic adjustment in the goods market is standard. Excess demand triggers firms to increase the rate of utilization. Since  $u = g^I/s$ , this can be written as

$$\dot{u} = \alpha \left( \frac{g^I}{s[\psi]} - u \right),$$

where  $\alpha$  is a sign-preserving speed of adjustment parameter. With the rate of utilization the adjusting variable, the dynamics best describe the short run.<sup>8</sup>

A generic wage curve describes bargaining,

$$w = w[e] = w \left[ \frac{u\theta}{\xi} \right],$$

with  $e$  the employment rate, and  $\theta$  the technologically determined full employment capital labor ratio. In what follows, we set  $\theta = 1$  for simplicity. Generically, endogenous labor productivity is

$$\xi = \xi[u].$$

The price and distribution system can be described by the dynamics of the wage share. Following the theory of conflict inflation (Rowthorn (1977), Taylor (1991)), prices and distributive shares are subject to class conflict, so that the change in the wage share becomes

$$\dot{\psi} = \beta \left( \frac{w[u/\xi[u]]}{P\xi[u]} - \psi \right),$$

with  $\beta$  as well a sign-preserving speed of adjustment parameter. The bargained nominal wage rises with higher demand, but falls with higher productivity due to the negative effect on employment. The differential equation simply means that real wage increases in excess of productivity increases lead to a higher wage share. Note that we will assume here that inflation is constant (or zero); in other words, we consider a *real* wage curve.<sup>9</sup> The dynamic behavior of the system can be summarized in the Jacobian

$$J = \begin{pmatrix} -\alpha & -\alpha \frac{g^I}{s^2} s_\psi \\ \beta\gamma & -\beta \end{pmatrix},$$

<sup>8</sup> See Lavoie (1995) for a discussion of the role of the rate of utilization in Kaleckian and Ricardian models. Related, and more recently, Skott (2008) argues that the rate of utilization can not be a long-run accommodating variable.

<sup>9</sup> The response of prices to utilization depends as well on the relative strength of the wage and productivity response to higher utilization. Nominal unit labor costs fall if productivity responds more strongly than wages, and vice versa. The system could be set up in the rate of utilization and prices and would show the same dynamics. Since the derivation is somewhat more cumbersome but less clear we chose this route instead.



where subscripts denote partial derivatives. The sign of the upper right entry is positive ( $s_\psi < 0$ ), and determines the demand regime as wage-led. The sign of the lower left entry determines the distributive regime:

$$\gamma = \xi^{-2} \left( w_u - w \xi_u - \frac{u}{\xi} w_u \xi_u \right)$$

is either greater or smaller than zero. Since both entries on the main diagonal are negative,  $\gamma < 0$  would ensure a positive determinant. The system is then stable with wage-led demand and forced saving distributional adjustment. If  $\gamma > 0$ , and distributional adjustment exhibits a profit squeeze,  $\text{Det}[J] > 0$  if

$$-\frac{g^I}{s^2} s_\psi \gamma < 1,$$

which is certainly satisfied, even with substantial difference in class saving rates and a private sector deficit, as long as  $\gamma$  is not “large.”

Let us now include net exports. The change in the utilization rate can be written as

$$\dot{u} = \alpha \left( \frac{g^I + g^N[u, \psi]}{s[\psi]} - u \right),$$

where  $g^N = (E - M)/K$  is the ratio of net exports to the capital stock. It responds negatively to utilization and real unit labor costs. This is surely a stylized net export function, but since domestic wage increases lead to a higher price level and real appreciation, the assumed mechanism is not too far fetched. See Naastepad (2006) for extensive discussion of a model with a similar set up. The first row of the Jacobian changes:

$$J = \begin{pmatrix} \alpha \left( \frac{g_u^N}{s} - 1 \right) & \frac{\alpha}{s} \eta \\ \beta \gamma & -\beta \end{pmatrix},$$

where

$$\eta = (g_\psi^N - g_\psi^S)$$

can take either sign. (Note that  $g_\psi^S = s_\psi u$ .) If negative, reduced real unit labor costs have a stimulating effect, because the increase in external demand outweighs the decrease in consumption. This case corresponds to a profit-led demand regime,  $\eta > 0$  is wage-led. Since  $g_u^N < 0$ , the upper left entry is still negative, and larger in magnitude: Imports stabilize quantity adjustment. As a result, the trace remains negative. For the sign of the determinant, two cases need to be distinguished: If  $\gamma$  and  $\eta$  are of opposite sign,  $\text{Det}[J] > 0$ , and the system is stable. If  $\gamma$  and  $\eta$  are of same sign,  $\text{Det}[J] > 0$  if  $s - g_u^N > \gamma \eta$ . The potential instability in the second case arises due to the positive feedback, for example, from higher costs through wage-led demand to higher demand, and from higher demand via profit squeeze to higher wage shares. As above, the own feedback channels tend to be stronger than the distributive-demand links, certainly making the sum  $s - g_u^N$  larger than the product  $\gamma \eta$ .

### ***The multi-region model: International closure and calibration***

The multi-region model has the same structure as the simple model presented above. The equations of the multi-region model are listed in Table 3. Here, we want to focus on bilateral trade and exchange rates. Each country features a real import demand function vis-à-vis any other country, with the bilateral real exchange rate and the importing country's level of income as arguments. The country's total



imports and exports follow from the relevant aggregation: Summation across all other countries' imports from this country implies an aggregate export function; summation across all other countries' exports to this country implies an aggregate import function. See Equation 12 in Table 3 for the latter.

Let us as well briefly consider the system of exchange rates. Note that there are two regions for the Eurozone, both of which of course share the same currency—which means that there are  $n - 2 = 14$  exchange rates. Given that the US dollar serves as the world reserve currency, it makes sense to express all exchange rates in terms of it. As an example, real exchange rates between three countries and the US indexed as country 1 can be written as

$$\rho[1,2] = \frac{e[1,2]P[2]}{P[1]}, \rho[2,1] = \frac{1}{\rho[1,2]} = \frac{P[1]}{e[1,2]P[2]}, \rho[2,3] = \frac{e[1,3]P[3]}{e[1,2]P[2]},$$

and analogously for all other countries. The important implication is that a model with sixteen regions with fifteen currencies has only fourteen degrees of freedom in international accounts, but twenty nine candidate variables: The fourteen exchange rates as well as fifteen current accounts. Simulation scenarios and simulation results depend crucially on international “closure” assumptions. A system similar to the one suggested here has been used in von Arnim (2009). That as this one is a straightforward multi-country extension of standard income- and elasticities approaches in open economy macroeconomics. Here, the focus will be on fixed nominal exchange rates and endogenous current accounts.

Before we move on to scenario analysis, let us explain the calibration of crucial parameters. We should distinguish between *accounting* and *behavioral* parameters. Accounting parameters are implied by data; examples include tax rates as well as macroeconomic savings propensities. The distribution of savings between wage and profit recipients ( $s_\psi$  and  $s_\pi$ ), however, is not set by the data, and therefore behavioral. Other behavioral parameters are the employment rate elasticity of nominal wages ( $w_1$ ), the demand elasticity of labor productivity ( $\xi_1$ ), and price and income elasticities of imports.

We estimate these trade elasticities for many countries in our data set, and apply GDP-weighted averages to the relevant regions.<sup>10</sup> For the savings parameters, we assume that profit income recipients save twice as much as wage income recipients.<sup>11</sup> We set the demand elasticity of productivity  $\xi_1 = 0.4$ , which implies  $\hat{L} = 3/5 \hat{Y}$ .<sup>12</sup> Broadly in line with Okun's and Verdoorn's Laws, employment grows only a bit more than half as fast as demand.<sup>13</sup> Lastly, we set  $w_1 = 0.75$ . Ideally, of course, all these elasticities should be estimated for each single country.

<sup>10</sup> The elasticities applied are uniform across trade partners. Ideally, trade elasticities should be bilateral, but the data requirements for the estimations are exorbitant, and we have to content ourselves with what is available.

<sup>11</sup> Equation 15 in Table 3 offers one degree of freedom, the second—to determine both  $s_\psi$  and  $s_\pi$ —comes from the assumption about the relationship between the two parameters. Given levels of base year GDP and savings as well as the profit share, we can then solve for  $s_\psi$  and  $s_\pi$ .

<sup>12</sup> A ‘hat’ over a variable denotes a proportional growth rate.

<sup>13</sup> For recent empirical discussions of these matters, see the seminal collection in McCombie *et.al.* (2003), as well as Chen *et.al.* (2007). Naastepad (2006), p.409, presents a short but fitting discussion of causal links.

For this paper, our focus is on trade elasticities, so that we complement the discussion with sensitivity analysis of selected parameters.<sup>14</sup> See Figure 1. As expected, an increase in the average employment rate elasticity of nominal wages  $w_1$  across countries increases the world GDP growth rate—since demand is wage-led, a higher increase in nominal wages presents further gains. Similarly, an increase in the average ratio of class savings propensities  $s_\psi/s_\pi$  leads to higher GDP growth—since demand is wage-led, similar class behavior reduces the impact of redistribution on the multiplier. Lastly, we test the impact of changes in the US trade elasticity. Overall, these tests suggest that simulation results are not dominated by reasonably expected variations on these parameters.

#### 4. Scenarios

This section reports simulation results. Four scenarios are considered, all with an eye towards effects on global growth and imbalances. We begin with a reduction of US government borrowing, often touted as the solution to US external imbalances. However, as will be seen, improvements in external balance come at a significant cost in terms of output and employment. Second, a revaluation of China's currency vis-à-vis the US dollar is necessary in the medium run to support rebalancing, but in the short run might not help as much as often hoped. Third, incomes and social policies in Asia's surplus countries can aid rebalancing and support global recovery. Fourth, we consider coordinated policies between Asia and Europe. In addition to the policy changes applied in scenario 3, we introduce nominal wage increases and fiscal expansion in European surplus countries. Table 6 presents an overview of key macroeconomic statistics for all four scenarios, and Tables 7-10 more detailed results for each in turn.

##### ***Reduction of US public deficit***

There are several reasons to consider a reduction of US public borrowing. The political pressure to reduce public debt is immense, even in the face of continued high unemployment. It is often said that the US's profligate ways have to change, that her overall rate of saving has to increase. Without that, the argument goes, the external deficit cannot be corrected. Reducing government dissaving is one way to do that, one that plays into entrenched beliefs about twin (public and external) deficits.<sup>15</sup> To implement this simulation, the ratio of the public deficit to GDP in the US is decreased by two percentage points, from the base year value of 6.6 per cent to 4.6 per cent. (Note that the government deficit usually is endogenous, but now fixed, and real government expenditures are made flexible to achieve this target.) Simulation results are shown in Table 7.<sup>16</sup>

The immediate effect is a sizable contraction of GDP in the US. The US unemployment rate increases by three percentage points. US external balance relative to GDP improves by about 1.4 percentage

<sup>14</sup> For sensitivity analysis, we calibrate the model with the behavioral parameter under consideration drawn from a uniform probability distribution with appropriate bounds, and repeatedly solve the model subject to a generic shock. See Figure 1 for further details, and von Arnim (2011) for a similar procedure applied to a structurally similar model.

<sup>15</sup> The argument works through the interest channel: budget deficits push up interest rates which lead to portfolio investment and exchange appreciation. The resulting trade deficit adds to global imbalances. Salvatore (2007) investigates the case empirically; Mussa (2007) suggests that particularly in the US case, this is "largely nonsense." See as well Barbosa-Filho et.al. (2008) for evidence that private and external deficit coincided over the relevant period.

<sup>16</sup> The aggregation in the results tables (6 through 10) differs from the regional aggregation fed into the model. This is for the reader's convenience, since we are most interested in the performance of commonly used regional aggregates.

points. A success? Not so: Real exports actually decrease, while real imports fall by much more. Due to the slight real depreciation real exports decrease more moderately than those of other countries. Specifically, improvement in the current account is the result of reduced income and import demand. This reduction of external demand for the rest of the world is sufficiently large to induce a global downturn.

Regional trade links are important for the international transmission of the shock. The US is by far the most important export market for both Canada and Latin America and the Caribbean. About three quarters of all exports from Canada go to the US, from Latin America about half. The sharp decrease of total import volume makes these two regions particularly vulnerable to the US downturn. Their negative GDP growth rates rank second, for Latin America, and third for Canada behind the US, where the shock originates. Because the US and Canada weigh heavily among developed countries, the recession is more pronounced there than in developing countries, even though Japan and Europe are not much affected. Globally, the contraction of demand does lead to correction of global imbalances by one fifth of a percentage point of world GDP. However, it comes at a significant cost. The global increase in unemployment rates does not bode well for a sustained recovery from the crisis with early exit from fiscal support.

To summarize, let us emphasize the relevant chain of causation: First, the US reduces domestic demand. The country falls into recession. GDP decreases, and the unemployment rate rises. Through the demand channel, US imports fall, which spreads the contraction particularly to important trade partners. On the price side, wages—key cost item—fall, which leads to deflation. This is most pronounced in the US, where the shock emanates. As a result, the country's external *price* competitiveness improves, which buffers the decrease in real exports from demand contraction in the rest of the world. Overall, quantity effects rule, as would be expected in a demand-driven model.

Next, we consider a price shock.

### ***Revaluation of China's currency***

Chinese monetary authorities have accumulated tremendous amounts of US dollar reserves in their efforts to maintain a stable and competitive exchange rate. The current account surplus relative to GDP has steadily increased, and in 2008 stood at about nine per cent of GDP. The US-China bilateral current account features prominently, with about 150bn USD worth of goods and services more sold to the US from China than vice versa. Attempting to counteract negative effects of the global crisis, currency policy had "re-stiffened" in late 2008, after a period of somewhat faster nominal appreciation. Currently, the Chinese yuan is traded in a carefully designed daily band.

What would revaluation of the Chinese currency do for global rebalancing? The simulation is implemented through a twenty percent increase of the US dollar price of one Chinese yuan. Since all other nominal exchange rates are assumed unchanged, this implies a nominal appreciation of China's currency by almost 17 per cent against all other region's currencies. The result is a real effective appreciation of about fourteen per cent. As a result, the current account to GDP ratio *increases* from 9 to 9.2 per cent: The proportional change of GDP is larger than that of net exports. See Table 8. In the

short run, revualation does not do much for reducing global imbalances. In fact, relative to the base year, global imbalances *increase*, even if only marginally.<sup>17</sup>

In the US, on the other hand, the real depreciation of about 1.8 per cent is *contractionary*. Real depreciation can be contractionary if trade elasticities are low, and the shock transmission through regional trade links does not work in favor of the country under consideration. For the US, both are the case. Not only is her import price elasticity relatively low, but Latin America—together with Canada, both at roughly twenty per cent—represents a crucial export market; in this simulation Latin America shows the second worst GDP growth performance.

In summary, currency depreciation in the US does *not* lead to an increase in real exports, since trade elasticities of key trade partners are too low, but *does* lead to a higher import bill. The result is contraction. In China, currency appreciation reduces net exports, and triggers contraction. On the price side, China experiences deflation, whereas the US imports inflation. These results probably should be qualified. There are good reasons to believe that the J-curve will turn. Over the medium run, sectoral reallocation can take place, and will aid adjustment.

What does it all mean for China? The unemployment rate rises by more than one and a half percentage points. The socio-economic implications of the lack of continued strong formal sector job growth make this a difficult political option to pursue. There are, however, alternative policies that do not have this negative impact, and have greater potential to aid reduction of global imbalances. One example might be income policies in Asian surplus countries.

### ***Rebalancing Asia***

For Asia, the rebound from the radically fast and sharp drop in external demand has been surprisingly short. Deepening regional integration plays a role, as does the growth of domestic markets. Significant fiscal stimulus has as well helped to mitigate adverse effects, and it represents a step in the direction of rebalancing demand towards domestic sources. What beyond fiscal stimulus can the region do to aid global rebalancing without endangering recovery? This simulation emphasizes the positive effects of higher social spending and improved social security nets. Ideally, transfer of social insurance to the public provides an immediate *double* benefit—the initial increase in spending and a resulting decrease in precautionary saving rates from lower income households. The policy changes are implemented here in the Asian surplus region (AS) and China (BR4) as a decrease of the net tax rate and a decrease in the propensity to save of wage earning households. Additionally, it is assumed that overall nominal wages increase. Such a shift further supports domestic consumption, without directly hurting external competitiveness through nominal exchange appreciation.<sup>18</sup>

<sup>17</sup> Imbalances improve—in the sense that they become smaller, whether initially positive or negative—only in Japan, Canada, Brazil, Russia, China and energy exporting countries. These improvements are often small. Here, as in the previous scenario, we focus on US-China economic relations.

<sup>18</sup> Tax rates are net of transfers, see the appendix for details. An increase in social transfers can be modeled by a decrease of this rate. It is decreased by 10 per cent. The propensity to save of wage earners is lowered by 10 per cent; assumed to be a result of improved social security (and therefore lower personal savings requirements). Nominal wages are shocked upward by 10 per cent. (Note that the nominal wage remains endogenous; in the wage curve only the intercept is increased by five per cent.)

Results are presented in Table 9, and are clearly globally reflationary. For the rest of the world, higher growth in Asia represents increased external demand. Global imbalances are reduced slightly. China grows strongly at almost 4 per cent. China's current account surplus relative to GDP falls significantly compared to the base year, from 9 to 6.7 per cent. The Asian aggregate region grows as well at almost 2 per cent, but its aggregate external deficit increases slightly. That is largely due to the fairly strong in-region growth; the Asian deficit region's current account relative to GDP worsens by half a percentage point, outweighing the Asian surplus region's reduction. Income inequality—as measured by the functional distribution of income—decreases.<sup>19</sup> Increases of the wage share should be interpreted carefully. Principally, wage share changes in this model are cyclical, and it is not obvious that they will last. However, if higher real wages become structurally embedded, they can translate into improvements in the personal distribution of income, even if productivity growth catches up. Fiscal balances across Asia remain sound. In summary, strengthening social safety nets represents an additional route for Asian economies to reduce dependence on exports, to deepen domestic markets, and to contribute to sustainable recovery from the *Great Recession*.

#### ***A coordinated scenario: Pro-labor policies in surplus countries***

Europe is only the most recent pinball of global financial turmoil that began in 2008. The *Great Recession* has strained previously sound fiscal balances, for example in Spain, and has exposed less sound fiscal balances in Greece. The contention that these countries can liquidate themselves back to health appears to be always briefly popular with investors, until it is remembered that fiscal restraint is contractionary, and very well can increase the ratio of public deficit to GDP. The vacuous but excited debate about these issues takes the light from where it should be shone: The fact that “common” monetary policy is made in the spirit of and for Germany, and no common fiscal policy exists. The practical question is what Europe can do about its internal imbalances, aside from various “lifeline” stability funds.

The answer to this question must be a political one; the model certainly cannot answer such questions. It can, however, point towards the principal changes necessary for internal rebalancing. As on a global level, rebalancing requires expenditure shifts and the corresponding price changes. Within the Eurozone, nominal exchange rate changes cannot help; the burden of adjustment falls on wages, and nominal wage increases in Eurozone surplus countries are one possible way to go. Further fiscal expansion is another.

In this scenario, we increase nominal wages and real government expenditures in Eurozone surplus countries by ten per cent, *in addition* to the social and pro-labor policies applied in the previous (Rebalancing Asia) scenario. The results are clearly expansionary *and* reduce global imbalances. The chain of causation begins with increased domestic demand in surplus countries. Income and consumption growth in Eurozone and Asian surplus countries reduces global imbalances through the reduction of their surplusses. Imports increase through the income channel, and exports decrease

<sup>19</sup> In the result tables, the proportional change of the labor share of income is equal to the difference between real wage growth and labor productivity growth.

through the relative price channel. Crucially, the results show a global improvement in the functional distribution of income. This scenario highlights that rebalancing does not have to be—indeed, should not be—driven by contraction and deflation, but rather by a set of coordinated policies in surplus countries that reduce inequality and foster domestic demand.

## 5. Conclusions

What can be concluded based on these thought experiments? Policy makers around the world have at their disposal the tools to sustain a healthy global recovery as well as a reduction of global imbalances. In all regions, a crucial issue might be to think outside of the respective regional orthodoxy. Broad application of a variety of policies—including increased social spending, wage policies, and well targeted transfers—might replace the received wisdom of targeting inflation and letting “the markets” figure out the rest. Importantly, none of the examples laid out here lead to exploding government borrowing. To be sure, the model is ill-suited to address the issue of debt sustainability, but surely highlights the fact that pro-cyclical macroeconomic policies do not aid recovery and rebalancing.

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## 7. Tables and figures

	GDP	Shares		u	S-I	T-G	E-M	S/Y	T/Y	E/Y	E/W
<b>World</b>	<b>60404</b>			<b>6.2</b>	<b>3.4</b>	<b>-3.4</b>	<b>-2.6</b>	<b>24.0</b>	<b>17.3</b>	<b>22.0</b>	
<b>Developed</b>	<b>39909</b>	<b>66.1</b>		<b>6.1</b>	<b>1.9</b>	<b>-3.8</b>	<b>-1.9</b>	<b>18.8</b>	<b>19.0</b>	<b>18.2</b>	<b>54.6</b>
<b>US</b>	14395	23.8	36.1	5.7	1.4	-6.6	-5.2	13.7	16.0	9.1	9.9
<b>Europe</b>	18963	31.4	47.5	6.9	1.5	-2.4	-0.9	20.9	20.9	25.0	35.6
<b>Japan</b>	5057	8.4	12.7	3.9	5.6	-2.6	3.1	25.4	18.5	15.3	5.8
<b>Canada</b>	1494	2.5	3.7	5.9	-1.5	2.0	0.5	19.3	24.5	30.4	3.4
<b>Developing</b>	<b>17490</b>	<b>29.0</b>		<b>6.4</b>	<b>3.6</b>	<b>-1.8</b>	<b>1.8</b>	<b>32.4</b>	<b>14.8</b>	<b>26.0</b>	<b>34.2</b>
<b>Developing, excl. BRICS</b>	<b>8009</b>	<b>13.3</b>	<b>45.8</b>	<b>6.7</b>	<b>1.5</b>	<b>-3.0</b>	<b>-1.6</b>	<b>25.7</b>	<b>11.8</b>	<b>29.3</b>	<b>17.6</b>
<b>Asia</b>	5105	8.5	29.2	6.2	2.6	-3.8	-1.2	28.0	11.5	32.9	12.6
<b>Latin America</b>	2308	3.8	13.2	5.2	-0.8	-0.9	-1.7	22.5	12.7	23.8	4.1
<b>Africa</b>	597	1.0	3.4	16.3	0.2	-4.5	-4.2	20.7	10.7	20.5	0.9
<b>BRICS</b>	<b>9481</b>	<b>15.7</b>	<b>54.2</b>	<b>6.1</b>	<b>5.4</b>	<b>-0.8</b>	<b>4.6</b>	<b>38.0</b>	<b>17.3</b>	<b>23.3</b>	<b>16.6</b>
<b>Brazil</b>	1571	2.6	9.0	8.1	1.1	-2.8	-1.7	19.1	19.4	14.2	1.7
<b>Russia</b>	1614	2.7	9.2	6.3	1.6	4.1	5.7	24.1	25.5	29.2	3.5
<b>India</b>	1281	2.1	7.3	7.3	3.6	-5.8	-2.3	37.1	9.6	17.1	1.6
<b>China</b>	4749	7.9	27.2	4.2	9.4	-0.4	9.0	50.6	15.6	25.3	9.0
<b>South Africa</b>	266	0.4	1.5	21.4	-7.1	-1.1	-8.2	12.8	23.9	33.5	0.7
<b>Energy exporters</b>	<b>3006</b>	<b>5.0</b>		<b>6.8</b>	<b>22.2</b>	<b>-7.5</b>	<b>14.7</b>	<b>45.0</b>	<b>9.7</b>	<b>49.3</b>	<b>11.1</b>
<b>AFR: Africa</b>	597	1.0		16.3	0.2	-4.5	-4.2	20.7	10.7	20.5	0.9
<b>AD: Asia (D)</b>	2729	4.5		8.0	0.1	-4.2	-4.0	23.9	11.7	29.6	6.1
<b>AS: Asia (S)</b>	2375	3.9		4.3	5.5	-3.4	2.1	32.2	11.4	36.6	6.5
<b>BRICS1: Brazil</b>	1571	2.6		8.1	1.1	-2.8	-1.7	19.1	19.4	14.2	1.7
<b>BRICS2: Russia</b>	1614	2.7		6.3	1.6	4.1	5.7	24.1	25.5	29.2	3.5
<b>BRICS3: India</b>	1281	2.1		7.3	3.6	-5.8	-2.3	37.1	9.6	17.1	1.6
<b>BRICS4: China</b>	4749	7.9		4.2	9.4	-0.4	9.0	50.6	15.6	25.3	9.0
<b>BRICS5: South Africa</b>	266	0.4		21.4	-7.1	-1.1	-8.2	12.8	23.9	33.5	0.7
<b>CAN: Canada</b>	1494	2.5		5.9	-1.5	2.0	0.5	19.3	24.5	30.4	3.4
<b>EN: Energy</b>	3006	5.0		6.8	22.2	-7.5	14.7	45.0	9.7	49.3	11.1
<b>EUR: Europe</b>	5578	9.2		5.7	-0.2	-3.0	-3.2	18.2	20.8	24.1	10.1
<b>EZD: Eurozone (D)</b>	7851	13.0		8.2	-1.6	-3.6	-5.2	19.6	20.8	18.1	10.7
<b>EZS: Eurozone (S)</b>	5534	9.2		6.3	7.5	0.0	7.4	25.4	21.3	35.6	14.8
<b>JAP: Japan</b>	5057	8.4		3.9	5.6	-2.6	3.1	25.4	18.5	15.3	5.8
<b>LAC: Latin America</b>	2308	3.8		5.2	-0.8	-0.9	-1.7	22.5	12.7	23.8	4.1
<b>US: United States</b>	14395	23.8		5.7	1.4	-6.6	-5.2	13.7	16.0	9.1	9.9

**Table 1: Macroeconomic data (National accounts, unemployment, related shares)**

The table reports GDP and related shares, unemployment rate and ratios of private, public and external balance, private savings, taxes and exports to GDP, as well as the share of exports in world exports. Values are in billions of 2008 USD. Rates are in percentage points. The upper part shows a regional aggregation that corresponds to reported simulation results. The lower part shows the same data for the sixteen countries and regions. Sources: UN SNA, IMF IFS and national statistics offices of selected countries. See the appendix.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	AFR	AD	AS	BR1	BR2	BR3	BR4	BR5	CAN	EN	EUR	EZD	EZS	JAP	LAC	US
	Africa	Asia (D)	Asia (S)	Brazil	Russia	India	China	South Africa	Canada	Energy	Europe	Euro (D)	Euro (S)	Japan	Lat. Am.	US
1		7	3	3	2	5	4	3	1	16	8	39	11	3	8	11
2	7		112	12	29	15	123	4	13	101	60	78	57	45	33	118
3	8	139		13	12	34	109	9	14	69	51	51	64	126	23	147
4	3	8	8		7	1	25	2	3	29	10	22	21	8	44	32
5	3	47	10	5		3	20	0	2	38	126	78	97	11	3	28
6	6	24	25	5	2		17	3	2	54	13	20	11	4	4	27
7	15	140	108	22	47	28		10	23	116	84	97	116	99	47	252
8	7	5	4	1	1	4	8		1	6	11	11	10	8	1	10
9	1	9	9	5	2	2	11	1		13	14	12	9	11	16	339
10	19	165	99	30	14	81	115	25	29		103	228	118	155	34	272
11	13	64	56	16	90	20	26	10	24	123		334	417	18	19	113
12	36	67	52	22	50	14	34	9	17	146	352		450	20	36	117
13	14	67	63	24	72	13	60	17	21	130	560	699		27	36	168
14	4	86	146	11	27	6	127	6	17	54	32	38	44		30	143
15	2	13	10	43	5	4	29	2	29	36	16	36	30	14		280
16	9	76	115	39	20	17	69	9	249	109	83	93	104	67	254	
17	123	807	870	223	472	219	1203	89	453	1484	1344	1425	1972	772	549	1313
18	148	917	821	250	379	248	776	111	446	1040	1523	1835	1561	616	588	2058
19	-25	-110	49	-27	93	-29	426	-22	8	444	-180	-411	411	156	-39	-745
1		0.2	0.1	0.1	0.1	0.3	0.1	0.7	0.0	0.4	0.1	0.4	0.2	0.0	0.3	0.1
2	1.0		3.5	0.7	1.5	1.0	2.2	1.1	0.7	2.5	0.9	0.8	0.8	0.8	1.1	0.7
3	1.0	3.8		0.7	0.6	2.2	2.0	2.3	0.7	1.7	0.7	0.5	0.9	2.2	0.8	0.9
4	0.3	0.2	0.3		0.3	0.1	0.5	0.6	0.2	0.7	0.1	0.2	0.3	0.1	1.5	0.2
5	0.4	1.3	0.3	0.3		0.2	0.4	0.1	0.1	0.9	1.8	0.8	1.4	0.2	0.1	0.2
6	0.9	0.7	0.8	0.3	0.1		0.3	0.8	0.1	1.3	0.2	0.2	0.2	0.1	0.1	0.2
7	2.0	3.8	3.4	1.2	2.4	1.8		2.6	1.2	2.9	1.2	1.0	1.6	1.7	1.6	1.5
8	1.0	0.1	0.1	0.1	0.0	0.3	0.1		0.0	0.2	0.2	0.1	0.1	0.1	0.0	0.1
9	0.2	0.2	0.3	0.3	0.1	0.1	0.2	0.3		0.3	0.2	0.1	0.1	0.2	0.5	2.1
10	2.5	4.5	3.1	1.6	0.7	5.3	2.1	6.6	1.5		1.4	2.3	1.7	2.7	1.2	1.7
11	1.7	1.8	1.8	0.9	4.5	1.3	0.5	2.7	1.2	3.0		3.4	5.9	0.3	0.7	0.7
12	4.9	1.8	1.6	1.2	2.5	0.9	0.6	2.4	0.9	3.6	5.0		6.3	0.4	1.2	0.7
13	1.9	1.8	2.0	1.3	3.6	0.9	1.1	4.6	1.1	3.2	7.9	7.2		0.5	1.2	1.0
14	0.5	2.4	4.6	0.6	1.3	0.4	2.3	1.7	0.9	1.3	0.5	0.4	0.6		1.0	0.9
15	0.3	0.4	0.3	2.4	0.3	0.3	0.5	0.6	1.5	0.9	0.2	0.4	0.4	0.2		1.7
16	1.2	2.1	3.6	2.2	1.0	1.1	1.2	2.4	12.9	2.7	1.2	1.0	1.5	1.2	8.8	
	19.9	25.2	25.7	13.7	19.0	16.2	14.0	29.5	23.1	25.7	21.5	18.9	22.0	10.9	20.3	12.5

**Table 2: Bilateral trade matrix**

The upper part of this table reports 2008 trade volumes in billions of current US dollars in the base year model data set. (D) and (S) in the top row stand for the *Deficit* and *Surplus* region, respectively. Row 17 sums total country and region exports (across rows), row 18 sums total imports (along columns). Row 19 is the difference, the current account. In the lower part, each cell shows (in percentage points) the ratio of the corresponding cell in the upper part to regional total imports. The column sum of the lower part of the table reports the aggregate import share in total supply.

$P_i = [1 - \sum_{j=1}^n m_{ij}]Q_i + \sum_{j=1}^n m_{ij} e_{ij} P_j$	(Equation 1: Supply or output price)
$Q_i = [1 + \tau_i] \frac{w}{\xi} = \frac{1}{1 - \pi_i} \frac{w_i}{\xi_i}$	(Equation 2: Mark-up price or GDP deflator)
$w_i = w_{i0} \left[ \frac{L}{N} \right]^{w_{i1}}$	(Equation 3: Nominal wage)
$r_i = \pi_i \frac{Q_i Y_i}{P_i K_i}$	(Equation 4: Profit rate)
$\pi_i = 1 - \frac{w_i L_i}{Q_i Y_i} = 1 - \frac{\omega_i}{\xi_i}$	(Equation 5: Profit share)
$e_i = \sum_{j=1}^n t_{ij} e_{ij}$	(Equation 6: Trade-weighted nominal exchange rate)
$\rho_i = \sum_{j=1}^n t_{ij} e_{ij} \frac{P_j}{P_i}$	(Equation 7: Trade-weighted real exchange rate)
$X_i = C_i + I_i + G_i + E_i$	(Equation 8: Real total supply)
$C_i = (1 - s_i - tx_i) Q_i Y_i / P_i$	(Equation 9: Real consumption)
$Y_i = k_i (I_i + G_i + E_i)$	(Equation 10: Real GDP)
$k_i = \frac{1 - \sum_{j=1}^n m_{ij}}{1 - (\sum_{j=1}^n m_{ij})(1 - s_i - tx_i) Q_i / P_i}$	(Equation 11: Multiplier)
$M_i = \sum_{j=1}^n m_{ij} X_i = \sum_{j=1}^n m_{i0} \rho_{ij}^{-\alpha_{ij}} X_i^{\beta_{ij}}$	(Equation 12: Real imports)
$E_i = \sum_{j=1}^n m_{ji} X_j$	(Equation 13: Real exports)
$t_{ij} = \frac{P_i m_{ji} X_j + e_{ij} P_j m_{ij} X_i}{P_i \sum_{j=1}^n m_{ji} X_j + \sum_{j=1}^n e_{ij} P_j m_{ij} X_i}$	(Equation 14: Trade share)
$S_i = s_i Q_i Y_i = [s_{i\pi} - (s_{i\pi} - s_{i\psi})(1 - \pi_i)] Q_i Y_i$	(Equation 15: Private saving)
$S_{ig} = tx_i Q_i Y_i - P_i G_i$	(Equation 16: Government (dis)saving)
$\xi_i = \xi_{i0} \left[ \frac{Y_i}{K_i} \right]^{\xi_{i1}}$	(Equation 17: Labor productivity)
$L_i = \frac{Y_i}{\xi_i}$	(Equation 18: Employment)
$CA_i = P_i \sum_{j=1}^n m_{ji} X_j - \sum_{j=1}^n e_{ij} P_j m_{ij} X_i = -S_{if}$	(Equation 19: Current Account)

**Table 3: Equations of the multi-region model**

		Country	GDP	Calc.	Price	GDP	Source	Period			Price	GDP
1	AFR	Egypt	29%	66%	0.15	2.25	LL, R	1990-2009	1	AFR	-0.31	2.26
2	AFR	Morocco	15%	34%	-1.2	2.29	LL, R	1990-2008	2	AD	-0.27	0.79
3	AD	S. Korea	34%	45%	-0.28	0.36	1st, P	1990-2009	3	AS	-0.63	1.61
4	AD	Turkey	27%	36%	-0.11	1.16	LL, P	1990-2009	4	BR1	-0.82	1.91
5	AD	Israel	7%	9%	-0.24	0.92	LL, R	1990-2010	5	BR2	-0.50	1.50
6	AD	Pakistan	7%	9%	-0.87	1.45	1st, R	1990-2010	6	BR3	-0.74	1.47
7	AS	Australia	42%	53%	-0.90	1.91	KALY	1984-2003	7	BR4	-0.35	2.53
8	AS	Indonesia	20%	25%	-0.20	1.21	1st, R	1997-2009	8	BR5	-0.91	2.20
9	AS	Malaysia	9%	11%	-0.57	1.46	1st, R	1991-2010	9	CAN	-0.35	2.85
10	AS	Hong Kong	9%	11%	-0.36	1.24	1st, P	1990-2010	10	EN	-0.51	1.61
11	BR1	Brazil	100%	100%	-0.82	1.91	1st, P	1995-2009	11	EUR	-0.29	1.62
12	BR2	Russia	100%	100%	-0.50	1.50	Ivanova	1995-2005	12	EZD	-1.02	2.89
13	BR3	India	100%	100%	-0.74	1.47	KALY	1984-2003	13	EZS	-0.85	1.63
14	BR4	China	100%	100%	-0.35	2.53	1st, R	1990-2009	14	JAP	-0.28	1.65
15	BR5	South Africa	100%	100%	-0.91	2.20	LL, P	1990-2006	15	LAC	-0.38	2.11
16	CAN	Canada	100%	100%	-0.35	2.85	1st, P	1990-2009	16	US	-0.25	2.11
17	EUR	UK	47%	75%	-0.27	1.90	LL, P	1990-2009				
18	EUR	Switzerland	9%	15%	-0.43	0.73	1st, R	1990-2010				
19	EUR	Denmark	6%	10%	-0.23	0.84	1st, R	1990-2010				
20	EZD	France	35%	39%	-1.18	3.26	1st, R	1990-2009				
21	EZD	Italy	29%	32%	-0.92	2.60	KALY	1984-2003				
22	EZD	Spain	20%	22%	-0.93	2.71	KALY	1984-2003				
23	EZD	Belgium	6%	7%	-0.84	2.66	KALY	1990-2010				
24	EZS	Germany	66%	74%	-0.92	1.48	KALY	1984-2003				
25	EZS	Netherlands	16%	18%	-0.68	2.56	1st, P	1990-2010				
26	EZS	Austria	7%	8%	-0.60	.92	1st, P	1990-2010				
27	EN	Norway	14%	58%	-0.46	1.25	1st, P	1990-2010				
28	EN	Venezuela	10%	42%	-0.57	2.1	1st, R	1990-2008				
29	JAP	Japan	100%	100%	-0.28	1.65	1st, P	1990-2009				
30	LAC	Argentina	14%	18%	-0.51	1.24	1st, R	1993-2009				
31	LAC	Bolivia	1%	1%	-0.07	0.55	1st, R	1995-2009				
32	LAC	Mexico	46%	58%	-0.31	2.31	LL, P	1990-2009				
33	LAC	Columbia	11%	14%	-0.55	2.12	1st, R	1994-2010				
34	LAC	Chile	7%	9%	-0.38	2.72	LL, R	1996-2010				
35	US	US	100%	100%	-0.25	2.11	LL, P	1990-2009				

**Table 4: Import elasticities**

The table reports price and income elasticities of import demand for selected countries. See Table 2 or the appendix for abbreviations of regions. Trade elasticities are not based on bilateral trade data, but reflect each country's aggregate real import time series. Bilateral trade elasticities were not estimated due to data limitations and the scope of such an estimation. "GDP weight" is the in-region weight of the country. "Calc. weight" is the weight with which the reported elasticities enter the averaged regional elasticities in the right part of the table. For all regions except Africa and Energy Exporters, the countries entering the calculation represent at least 50% of composite GDP. In the column on sources, KALY represents elasticities taken from Kwack et. al. (2007, and Ivanova represents elasticities taken from Ivanova (2007). All other elasticities are based on own calculation. "LL" indicates a log-linear regression, "1<sup>st</sup>" a first-differenced model; "R" data based on IMF/IFS real exchange rate indexes, and "P" data based on the ratio of a domestic CPI and import prices, as well from IMF/IFS. The most robust results were used. See the appendix for more details.

	Country	GDP Weight	Calc. Weight	Wage share	Source	Data Year		Wage share
1	AFR Egypt	27%	66%	73.7	ILO	2005	1	AFR 69.02
2	AFR Morocco	14%	34%	60.0			2	AD 64.16
3	AD S. Korea	34%	56%	77.0	ILO	2006	3	AS 60.50
4	AD Turkey	27%	44%	48.0	EU	2008	4	BR1 60.00
5	AS Australia	42%	68%	60.7	EU	2008	5	BR2 44.80
6	AS Indonesia	20%	32%	60.0			6	BR3 82.00
7	BR1 Brazil	100%	100%	60.0		2005	7	BR4 61.70
8	BR2 Russia	100%	100%	44.8	Vasiliouk	2007	8	BR5 50.40
9	BR3 India	100%	100%	82.0	Rada	2000	9	CAN 60.80
10	BR4 China	100%	100%	61.7	Rada	2000	10	EN 60.00
11	BR5 South Africa	100%	100%	50.4	ILO	2004	11	EUR 67.17
12	CAN Canada	100%	100%	60.8	ILO	2006	12	EZD 63.77
13	EUR UK	47%		68.5	EU	2006	13	EZS 62.55
14	EUR EU27			64.5	EU	2008	14	JAP 57.70
15	EZD France	35%		65.3	EU	2008	15	LAC 49.80
16	EZD Italy	29%		62.9	EU	2008	16	US 65.70
17	EZS Germany	66%		62.2	EU	2008		
18	JAP Japan	100%	100%	57.7	ILO	2007		
19	LAC Argentina	14%	23%	60.0		2005		
20	LAC Mexico	46%	77%	46.7	ILO	2004		
21	US US	100%	100%	65.7	ILO	2006		

**Table 5: Wage shares**

The left part of the table reports wage shares for selected countries, their sources and data years. See Table 2 or the appendix for abbreviations of regions. "GDP weight" is the in-region weight of the country. "Calc. weight" is the weight with which the reported wage share enters the averaged regional wage share in the right part of the table. For the European countries, the Ameco database provides wage shares for (almost) all countries, so that exact weights were used. See the appendix for more details on data sources.

	Scenario 1: US				Scenario 2: Revaluation				Scenario 3: Asia				Scenario 4: Coordination			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	GDP	$\Delta u$	$\Delta ca$	$\Delta sg$	GDP	$\Delta u$	$\Delta ca$	$\Delta sg$	GDP	$\Delta u$	$\Delta ca$	$\Delta sg$	GDP	$\Delta u$	$\Delta ca$	$\Delta sg$
<b>World</b>	-1.9	1.1	0.2	0.4	-0.2	0.1	-0.1	0.0	1.0	-0.6	0.1	0.0	1.6	-0.9	0.2	0.0
<b>Developed</b>	-2.4	1.4	0.3	0.6	-0.1	0.0	-0.1	-0.1	0.5	-0.3	0.2	0.1	1.2	-0.6	0.1	0.0
US	-5.5	3.1	1.4	2.0	-0.2	0.1	-0.2	-0.1	0.3	-0.2	0.1	0.0	0.5	-0.3	0.1	0.1
Europe	-0.7	0.4	-0.3	-0.1	0.1	0.0	-0.1	0.0	0.5	-0.3	0.2	0.1	1.6	-0.9	-0.1	-0.3
Japan	-0.9	0.5	-0.3	-0.2	-0.2	0.1	-0.2	-0.1	1.3	-0.7	0.4	0.2	1.6	-0.9	0.5	0.3
Canada	-1.5	0.8	-0.5	-0.3	0.0	0.0	-0.1	-0.1	0.2	-0.1	0.0	0.0	0.3	-0.2	0.0	0.0
<b>Developing</b>	-0.7	0.4	-0.7	-0.1	-0.7	0.4	0.2	0.0	2.0	-1.2	-0.5	-0.2	2.5	-1.5	-0.4	-0.1
Developing, ex BRICS	-1.5	0.9	-0.5	-0.2	-0.2	0.1	-0.3	-0.1	1.7	-1.0	-0.1	-0.1	2.2	-1.3	0.0	0.0
Asia	-1.5	0.9	-0.5	-0.2	-0.3	0.1	-0.4	-0.1	2.4	-1.4	-0.3	-0.1	3.1	-1.7	-0.1	0.0
Latin America	-1.7	1.0	-0.6	-0.2	-0.1	0.1	-0.2	-0.1	0.5	-0.3	0.1	0.0	0.7	-0.4	0.2	0.1
Africa	-0.4	0.2	-0.5	-0.1	-0.1	0.1	-0.3	-0.1	0.3	-0.1	-0.1	0.0	0.6	-0.3	0.0	0.1
BRICS	-0.1	0.0	-0.8	-0.1	-1.0	0.6	0.4	0.0	2.3	-1.4	-0.9	-0.3	2.8	-1.6	-0.7	-0.2
Brazil	-0.8	0.4	-0.3	-0.2	0.1	0.0	-0.1	0.0	0.7	-0.4	0.2	0.1	1.0	-0.6	0.4	0.2
Russia	-0.8	0.5	-0.3	-0.2	-0.1	0.0	-0.2	-0.1	0.7	-0.4	0.2	0.1	1.7	-1.0	0.6	0.3
India	-0.5	0.3	-0.4	-0.1	0.1	0.0	-0.1	0.0	0.8	-0.5	0.4	0.1	1.2	-0.6	0.5	0.1
China	0.5	-0.3	-1.2	0.0	-2.1	1.2	0.2	0.0	3.9	-2.2	-2.3	-0.7	4.2	-2.4	-2.2	-0.7
South Africa	-0.6	0.3	-0.2	-0.1	0.3	-0.2	-0.1	0.0	0.7	-0.3	0.2	0.1	1.2	-0.6	0.3	0.2
<b>Energy exporters</b>	-1.4	0.8	-0.6	-0.2	0.0	0.0	-0.2	-0.1	1.1	-0.6	0.4	0.2	1.7	-1.0	0.6	0.3

**Table 6: Scenario – Overview**

All entries are in percentage points. The columns report growth rates of GDP, the change in the unemployment rate, the change of the ratio of current account relative to GDP and the change of the ratio of government saving to GDP for four scenarios. Note that CA/Y for the World is the cumulative current account of all deficit regions.

	GDP	w/Q	Y/L	P	RER	u	CA/Y	SG/Y	E/W			
World	-1.88	-0.84	-0.76	-0.66		7.26	6.19	-2.41	-2.63	-3.02	-3.38	
Developed	-2.43	-1.69	-0.99	-0.30	-0.33	7.45	6.06	-1.56	-1.91	-3.13	-3.76	54.9
US	-5.46	-3.87	-2.22	-0.45	-0.22	8.81	5.69	-3.82	-5.18	-4.60	-6.55	9.9
Europe	-0.72	-0.44	-0.29	-0.21	-0.28	7.34	6.93	-1.20	-0.94	-2.56	-2.41	36.0
Japan	-0.93	-0.53	-0.37	-0.29	-0.75	4.39	3.86	2.75	3.07	-2.73	-2.55	5.8
Canada	-1.50	-1.38	-0.60	0.03	-0.61	6.70	5.86	0.02	0.53	1.70	2.00	3.2
Developing	-0.73	0.96	-0.29	-1.45	0.82	6.79	6.38	1.11	1.81	-1.95	-1.81	34.0
Developing, excl. BRICS	-1.51	-0.96	-0.61	-0.38	-0.45	7.60	6.74	-2.05	-1.55	-3.22	-3.02	17.5
Asia	-1.53	-1.12	-0.61	-0.30	-0.63	7.05	6.19	-1.66	-1.19	-4.01	-3.80	12.7
Latin America	-1.74	-1.01	-0.70	-0.42	-0.24	6.17	5.18	-2.27	-1.67	-1.15	-0.92	4.0
Africa	-0.39	0.77	-0.15	-1.00	0.38	16.50	16.31	-2.05	-1.55	-4.51	-4.45	0.9
BRICS	-0.08	2.56	-0.03	-2.35	1.87	6.12	6.09	3.81	4.65	-0.87	-0.79	16.4
Brazil	-0.77	-0.13	-0.31	-0.51	-0.28	8.54	8.11	-2.02	-1.71	-2.97	-2.81	1.7
Russia	-0.80	-0.37	-0.32	-0.35	-0.24	6.71	6.26	5.42	5.73	3.97	4.12	3.6
India	-0.53	0.35	-0.21	-0.79	-0.05	7.57	7.27	-2.67	-2.27	-5.92	-5.84	1.6
China	0.53	5.17	0.21	-4.14	3.92	3.89	4.19	7.74	8.98	-0.42	-0.40	8.8
South Africa	-0.63	-0.34	-0.25	-0.34	-0.43	21.66	21.36	-8.41	-8.21	-1.25	-1.14	0.7
Energy exporters	-1.37	-0.27	-0.55	-0.79	0.11	7.53	6.76	14.15	14.76	-7.72	-7.48	11.1

**Table 7: Scenario – Reduction of public deficit in US**

All entries are in percentage points. The columns report growth rates of GDP, the real wage, labor productivity, prices and the real effective exchange rate; as well as the unemployment rate, the current account relative to GDP, government saving relative to GDP, the share of country/region exports in world exports, and the respective base year (by) shares. Note that CA/Y for the World is the cumulative current account of all deficit regions.

	GDP	w/Q	Y/L	P	RER	u	CA/Y	SG/Y	E/W			
World	-0.24	-0.17	-0.10	0.11		6.33	6.19	-2.69	-2.63	-3.41	-3.38	
Developed	-0.08	-0.06	-0.03	0.27	1.43	6.10	6.06	-2.04	-1.91	-3.83	-3.76	54.2
US	-0.23	-0.15	-0.09	0.27	1.82	5.82	5.69	-5.36	-5.18	-6.67	-6.55	9.8
Europe	0.06	0.03	0.02	0.27	0.80	6.90	6.93	-1.02	-0.94	-2.46	-2.41	35.3
Japan	-0.18	-0.12	-0.07	0.31	2.95	3.96	3.86	2.87	3.07	-2.66	-2.55	5.8
Canada	-0.04	-0.03	-0.02	0.26	0.71	5.88	5.86	0.40	0.53	1.94	2.00	3.4
Developing	-0.66	-0.45	-0.26	-0.34	-2.52	6.77	6.38	2.05	1.81	-1.80	-1.81	34.7
Developing, excl. BRICS	-0.22	-0.13	-0.09	0.52	1.84	6.85	6.74	-1.84	-1.55	-3.13	-3.02	17.5
Asia	-0.25	-0.17	-0.10	0.64	2.17	6.33	6.19	-1.55	-1.19	-3.95	-3.80	12.5
Latin America	-0.12	-0.06	-0.05	0.30	1.20	5.25	5.18	-1.83	-1.67	-0.98	-0.92	4.1
Africa	-0.10	0.08	-0.04	0.26	1.37	16.36	16.31	-1.84	-1.55	-4.52	-4.45	0.9
BRICS	-1.03	-0.72	-0.42	-1.07	-6.23	6.71	6.09	5.07	4.65	-0.77	-0.79	17.2
Brazil	0.07	0.00	0.03	0.27	1.75	8.07	8.11	-1.76	-1.71	-2.84	-2.81	1.7
Russia	-0.05	-0.03	-0.02	0.42	1.30	6.28	6.26	5.52	5.73	4.02	4.12	3.5
India	0.08	-0.01	0.03	0.40	1.68	7.23	7.27	-2.38	-2.27	-5.88	-5.84	1.6
China	-2.13	-1.44	-0.86	-2.54	-14.1	5.42	4.19	9.22	8.98	-0.37	-0.40	9.7
South Africa	0.34	0.18	0.14	0.56	1.29	21.20	21.36	-8.27	-8.21	-1.17	-1.14	0.7
Energy exporters	-0.02	-0.02	-0.01	0.53	1.40	6.77	6.76	14.55	14.76	-7.58	-7.48	11.1

**Table 8: Scenario – Revaluation of CNY against USD**

See notes for Table 7.

	GDP	w/Q	Y/L	P	RER	u	CA/Y	SG/Y	E/W			
World	1.01	1.18	0.40	0.88		5.61	6.19	-2.50	-2.63	-3.35	-3.38	
Developed	0.55	0.34	0.22	0.24	0.81	5.74	6.06	-1.75	-1.91	-3.67	-3.76	54.3
US	0.34	0.21	0.14	0.20	0.98	5.50	5.69	-5.12	-5.18	-6.51	-6.55	9.8
Europe	0.54	0.32	0.21	0.24	0.47	6.63	6.93	-0.77	-0.94	-2.32	-2.41	35.1
Japan	1.25	0.82	0.50	0.36	1.74	3.13	3.86	3.46	3.07	-2.34	-2.55	5.9
Canada	0.23	0.20	0.09	0.13	0.44	5.73	5.86	0.55	0.53	2.02	2.00	3.4
Developing	2.05	3.21	0.81	2.35	-1.16	5.21	6.38	1.29	1.81	-1.99	-1.81	34.6
Developing, excl. BRICS	1.69	2.32	0.67	1.81	-0.54	5.78	6.74	-1.67	-1.55	-3.07	-3.02	17.9
Asia	2.42	3.73	0.96	2.75	-1.24	4.84	6.19	-1.45	-1.19	-3.86	-3.80	12.9
Latin America	0.46	0.25	0.18	0.26	0.52	4.92	5.18	-1.56	-1.67	-0.88	-0.92	4.1
Africa	0.30	-0.33	0.12	0.66	0.25	16.16	16.31	-1.67	-1.55	-4.42	-4.45	0.9
BRICS	2.35	3.96	0.93	2.81	-1.68	4.73	6.09	3.76	4.65	-1.09	-0.79	16.7
Brazil	0.68	0.14	0.27	0.47	0.59	7.74	8.11	-1.46	-1.71	-2.67	-2.81	1.7
Russia	0.75	0.46	0.30	0.30	0.56	5.84	6.26	5.97	5.73	4.24	4.12	3.5
India	0.84	0.18	0.33	0.65	0.87	6.81	7.27	-1.91	-2.27	-5.74	-5.84	1.7
China	3.89	7.51	1.54	5.08	-3.95	1.97	4.19	6.67	8.98	-1.12	-0.40	9.2
South Africa	0.71	0.39	0.29	0.46	0.68	21.03	21.36	-8.03	-8.21	-1.03	-1.14	0.7
Energy exporters	1.12	0.24	0.45	0.77	0.35	6.13	6.76	15.20	14.76	-7.32	-7.48	11.2

**Table 9: Scenario – Rebalancing Asia**

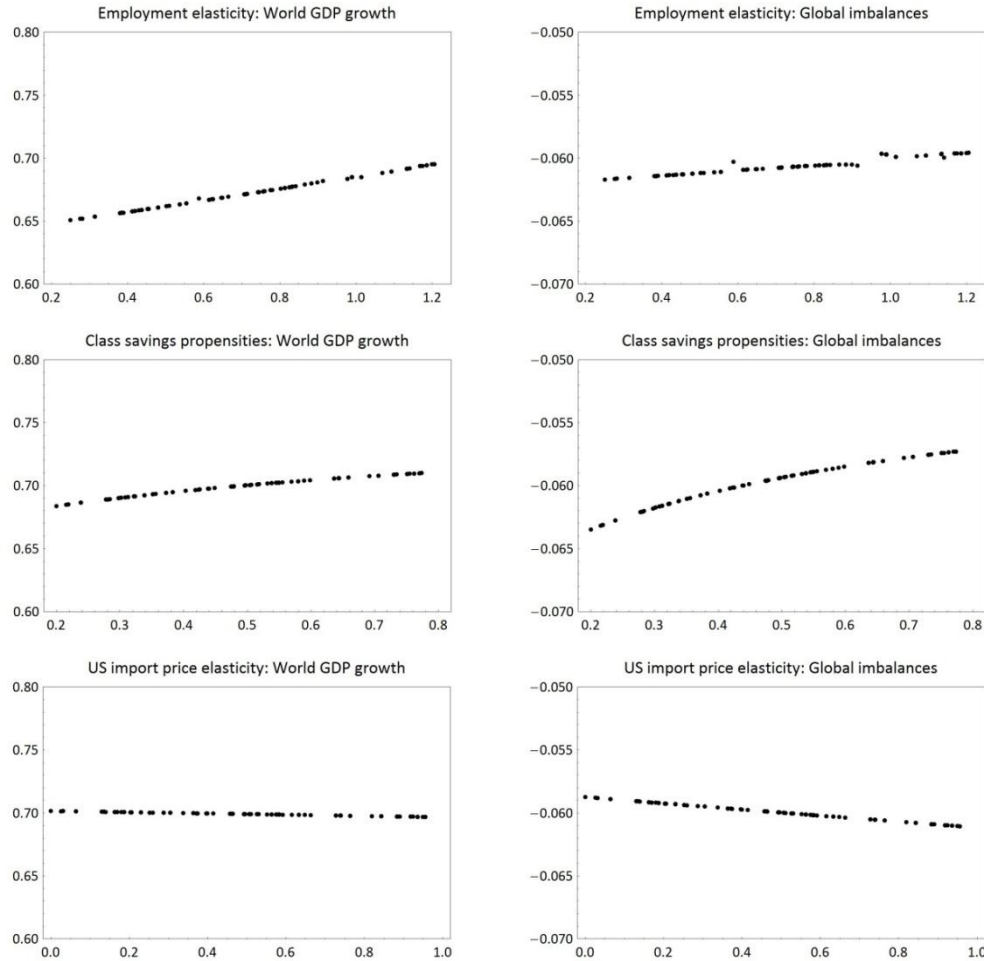
See notes for Table 7.

	GDP	w/Q	Y/L	P	RER	u	CA/Y	SG/Y	E/W			
World	1.58	2.03	0.63	1.43		5.29	6.19	-2.42	-2.63	-3.41	-3.38	
Developed	1.15	1.50	0.46	0.96	0.91	5.41	6.06	-1.83	-1.91	-3.80	-3.76	54.5
US	0.54	0.34	0.21	0.29	1.39	5.39	5.69	-5.08	-5.18	-6.48	-6.55	9.8
Europe	1.55	2.59	0.62	1.67	0.26	6.06	6.93	-1.02	-0.94	-2.66	-2.41	35.5
Japan	1.59	1.04	0.63	0.45	2.05	2.94	3.86	3.57	3.07	-2.27	-2.55	5.9
Canada	0.35	0.31	0.14	0.20	0.64	5.66	5.86	0.56	0.53	2.03	2.00	3.3
Developing	2.54	3.51	1.01	2.53	-0.80	4.93	6.38	1.45	1.81	-1.92	-1.81	34.4
Developing, excl. BRICS	2.23	2.69	0.88	1.97	-0.24	5.48	6.74	-1.53	-1.55	-3.01	-3.02	17.8
Asia	3.09	4.25	1.23	2.89	-0.90	4.46	6.19	-1.27	-1.19	-3.78	-3.80	12.8
Latin America	0.72	0.41	0.29	0.38	0.79	4.77	5.18	-1.49	-1.67	-0.85	-0.92	4.0
Africa	0.57	-0.66	0.23	1.23	0.33	16.02	16.31	-1.53	-1.55	-4.38	-4.45	0.9
BRICS	2.80	4.21	1.11	3.00	-1.27	4.47	6.09	3.93	4.65	-1.02	-0.79	16.6
Brazil	1.03	0.21	0.41	0.73	0.91	7.54	8.11	-1.33	-1.71	-2.61	-2.81	1.7
Russia	1.70	1.06	0.68	0.59	1.27	5.30	6.26	6.29	5.73	4.41	4.12	3.5
India	1.16	0.26	0.46	0.88	1.10	6.63	7.27	-1.76	-2.27	-5.70	-5.84	1.6
China	4.25	7.76	1.68	5.20	-3.55	1.77	4.19	6.81	8.98	-1.07	-0.40	9.1
South Africa	1.19	0.64	0.47	0.79	1.11	20.80	21.36	-7.92	-8.21	-0.97	-1.14	0.7
Energy exporters	1.71	0.36	0.68	1.20	0.50	5.80	6.76	15.41	14.76	-7.23	-7.48	11.1

**Table 10: Scenario – Coordination**

See notes for Table 7.





**Figure 1: Sensitivity analysis for model responses to a US investment shock**

This figure reports sensitivity analysis. For the top two panels, the horizontal axis shows employment rate elasticities  $w_1$  drawn from a uniform probability distribution with bounds 0.25 and 1.25. For the middle two panels, the horizontal axis shows the ratio of class savings propensities,  $s_\pi/s_\psi$ , drawn from a uniform probability distribution with bounds 0.2 and 0.8. For the lower two panels, the horizontal axis shows the US import price elasticity, drawn from a uniform probability distribution with bounds 0 and 1. The vertical axes show world GDP growth and the change in the ratio of cumulative world current account imbalance relative to GDP following an increase in US real investment that represents one per cent of US GDP. The vertical axes show percentage points.

## 8. Appendix

**Regional aggregation:** The model disaggregates the global economy into sixteen regions and countries. Some groups clearly contain fairly heterogenous countries. For example, Norway and Saudi Arabia are members of the energy exporting bloc. On the other hand, Germany and Greece, despite sharing the same currency, are featured in separate blocs. Similarly, the 'BRICS' – Brazil, Russia, India, China and South Africa – are considered individually, rather than subsumed in their geographical regional aggregates. Hence, the aggregation strategy generally places emphasis on the countries that have in recent years and throughout the current crisis featured prominently in the public debate. Below follows a complete list of countries covered in each region. In each region, the countries are sorted by the share of regional aggregate GDP, shown in parentheses. Note that a value of zero per cent indicates a value below one per cent; percentages do not add to 100 per cent due to rounding.

**AFR – Africa:** EGYPT (27%), MOROCCO (14%), TUNISIA (7%), KENYA (5%), ETHIOPIA (4%), COTE D IVOIRE (4%), TANZANIA (3%), GHANA (3%), UGANDA (3%), ZAMBIA (2%), SENEGAL (2%), CONGO, DEM. REP. OF (2%), MOZAMBIQUE (2%), MAURITIUS (2%), MADAGASCAR (2%), MALI (1%), CHAD (1%), BURKINA FASO (1%), BENIN (1%), NIGER (1%), GUINEA (1%), RWANDA (1%), MALAWI (1%), ZIMBABWE (1%), MAURITANIA (1%), TOGO (0%), SOMALIA (0%), SIERRA LEONE (0%), CENTRAL AFRICAN REP. (0%), CAPE VERDE (0%); **AD – Asia (Deficit countries):** KOREA, REPUBLIC OF (34%), TURKEY (27%), ISRAEL (7%), PAKISTAN (7%), PHILIPPINES (6%), NEW ZEALAND (5%), VIETNAM (3%), BANGLADESH (3%), SRI LANKA (2%), MYANMAR (1%), LEBANON (1%), JORDAN (1%), AFGHANISTAN, I.R. OF (0%), NEPAL (0%), GEORGIA (0%), ARMENIA (0%), CAMBODIA (0%), NEW CALEDONIA (0%), MONGOLIA (0%), KYRGYZ REPUBLIC (0%), FIJI (0%), TAJIKISTAN (0%); **AS – Asia (Surplus countries):** AUSTRALIA (42%),

INDONESIA (20%), THAILAND (11%), MALAYSIA (9%), CHINA, P.R.: HONG KONG (9%), SINGAPORE (7%), UZBEKISTAN (1%), CHINA, P.R.: MACAO (1%), PAPUA NEW GUINEA (0%); **BRICS1 – Brazil; BRICS2 – Russia; BRICS3 – India; BRICS4 – China; BRICS5 – South Africa; CAN – Canada; EN – Energy exporters:** SAUDI ARABIA (14%), NORWAY (14%), IRAN, I.R. OF (11%), VENEZUELA, REP. BOL. (10%), UNITED ARAB EMIRATES (9%), NIGERIA (7%), ALGERIA (5%), KUWAIT (5%), KAZAKHSTAN (4%), QATAR (3%), LIBYA (3%), SUDAN (2%), SYRIAN ARAB REPUBLIC (2%), OMAN (2%), ECUADOR (2%), AZERBAIJAN, REP. OF (1%), ANGOLA (1%), YEMEN, REPUBLIC OF (1%), TRINIDAD AND TOBAGO (1%), IRAQ (1%), CAMEROON (1%), BAHRAIN, KINGDOM OF (1%), LAO PEOPLE'S DEM. REP. (0%), NETHERLANDS ANTILLES (0%); **EUR – Europe (Rest of):** UNITED KINGDOM (47%), POLAND (9%), SWITZERLAND (9%), SWEDEN (8%), DENMARK (6%), CZECH REPUBLIC (4%), ROMANIA (4%), UKRAINE (3%), HUNGARY (3%), CROATIA (1%), BELARUS (1%), SERBIA, REPUBLIC OF (1%), BULGARIA (1%), LITHUANIA (1%), LATVIA (1%), ESTONIA (0%), BOSNIA & HERZEGOVINA (0%), ICELAND (0%), ALBANIA (0%), MACEDONIA, FYR (0%), MOLDOVA (0%), MONTENEGRO, REP. OF (0%); **EZD – Eurozone (Deficit countries):** FRANCE (35%), ITALY (29%), SPAIN (20%), BELGIUM (6%), GREECE (4%), PORTUGAL (3%), SLOVAK REPUBLIC (1%), SLOVENIA (1%), CYPRUS (0%), MALTA (0%); **EZS – Eurozone (Surplus countries):** GERMANY (66%), NETHERLANDS (16%), AUSTRIA (7%), FINLAND (5%), IRELAND (5%), LUXEMBOURG (1%); **JAP – Japan; LAC – Latin America and Caribbean:** MEXICO (46%), ARGENTINA (14%), COLOMBIA (10%), CHILE (7%), PERU (6%), CUBA (3%), DOMINICAN REPUBLIC (2%), GUATEMALA (2%), URUGUAY (1%), COSTA RICA (1%), EL SALVADOR (1%), PANAMA (1%), BOLIVIA (1%), PARAGUAY (1%), JAMAICA (1%), HONDURAS (1%), HAITI (0%), BAHAMAS, THE (0%), NICARAGUA (0%), BERMUDA (0%), BARBADOS (0%), SURINAME (0%), ARUBA (0%), GREENLAND (0%); **US – United States**

**GDP by Expenditure:** UN SNA <http://unstats.un.org/unsd/snaama/introduction.asp>: National accounts at the UN provide data on GDP in current USD by expenditure (G, C, I+Inventories, Ex, Im). The latest data is 2008. Data is provided on an annual basis only.

**Government:** Data on government expenditures is from the UN SNA overview of GDP by expenditure. Government revenues are from UN SNA Table 4.5 or, if unavailable there, Table 2.1. Taxes are net of transfers. More detail follows: The data on government expenditure in UN SNA GDP by expenditure excludes public investment. Since changes in the fiscal stance should be reflected in the government's balance, public investment has been subtracted from aggregate investment, and subsequently added to government consumption expenditures. Gross government investment, which is net of inventory changes, was collected from SNA Table 4.5, General Government (S.13). This data was used to adjust aggregate investment data to exclude government investment, and to increase government expenditure by the same amount. The data was available for 72 countries in the data base, accounting for 88.5% of the GDP in the 160 country data set. On government revenues, UN SNA Table 4.1 contains the most complete set of SNA accounts for 106 countries, and thus is the first choice for tax data collection. UN SNA Table 2.1 contains a subset of the total tax data, and is used only if the tax data is not available in Table 4.1. Since the 2008 data set is very incomplete, the methodology for estimating 2008 taxes from the SNA database for all estimated countries is to multiply the ratio of data-year taxes to data-year GDP, and multiply that by 2008 GDP. The total tax for the data year is accumulated from the following detailed fields:

- Plus Taxes on production and imports – SNA 93 Item Code D.2 - Uses
- Minus Subsidies on production and imports – SNA 93 Item Code D.3 - Uses
- Plus Current taxes on income, wealth, etc. – SNA 93 Item Code D.5 – Uses
- Plus Social contributions – SNA 93 Item Code D.61 – Uses

If the country does not report the Item Codes in Table 4.1, Table 2.1 contains the following field:

- Plus Taxes on products minus subsidies on products – SNA Item Codes D.21 – D.31

While data collected from Table 4.1 is disaggregated, data from Table 2.1 is possibly incomplete since it does not include income or wealth taxes or social contributions. However, many of the countries for which data is only available in Table 2.1 may not collect income or wealth taxes and social contributions. Their primary tax source is then production or value added taxes or tariffs, so that the majority of tax collections is reflected in Table 2.1. Social benefits, part of Table 4.1, were collected and netted against the gross tax rate. The current reported tax rate is thus net of any subsidies in the form of production or trade subsidies or social benefits. Individual countries (US, Japan, BRICS) as well as the largest countries in each bloc of the model have been verified on the basis of IMF International Financial Statistics and national statistics offices. For these countries, net taxes in the model database were adjusted to match government deficits (and surpluses) relative to GDP. Specifically, Eurozone as well as European countries' government deficit to GDP ratio was adjusted based on publications from the German national statistics office; Brazil and Mexico based on data from IADB (Inter American Development Bank); US based on US BEA (Bureau of Economic Analysis); Australia, China, India, South Korea and Japan based on data from ADB (Asian Development Bank); Russia based on data from EEG (Economic Expert Group, <http://www.eeg.ru/pages/345>) in association with the Ministry of Finance; Turkey and South Africa from respective national Treasury Departments.

**Bilateral trade matrix:** The principal source for the bilateral trade matrix is the IMF's DOTS (Direction of Trade Statistics), see <http://www2.imfstatistics.org/DOT>. The trade data is presented by "reporting countries" and "partner countries" for

exports and imports. The import matrix includes “cost insurance and freight,” often at a uniform rate of ten per cent across partner countries due to the general lack of data. Since imports are a cost item to the domestic firm in the model, the data used here relies mostly on the import matrix. Only where the export matrix provided additional data was it included. The DOTS data is aggregated into the region by region matrix that fits the model’s aggregation scheme. Intra-regional trade is not accounted for. The DOTS database covers only merchandise trade. In order to account for trade in services – and, in fact, for the overall current account – imports in the aggregated bilateral trade matrix have been scaled to reflect current accounts from the IMF’s International Financial Statistics. While this represents a crude adjustment, it is feasible, whereas more complicated measures would require a global bilateral services trade matrix – which is not available.

**Employment and unemployment data:** The following is a description of employment and unemployment data. In brief: Population, labor force, employment and unemployment data stems from national statistics offices, regional development banks as well as ILO’s Laborsta and Eapep databases. Reported unemployment rates are used where available, estimates based on the highest quality underlying data where not. Regional unemployment rates are calculated as GDP-weighted averages. More detail follows: From ILO’s Laborsta, Tables 1A, 2B, and 3D from the ILO laborsta database were used. 1A contains the total economically active population by country, and in some cases the total population. The years of data availability varied from 2000 to 2008. 2B contains the employed population by country. The years of data availability varied from 2000 to 2008, were matched when possible to the dates in Table 1A. Table 3D contains the unemployed population by country. The years of data availability varied from 2000 to 2008, and were matched to the date in Table 2B. From Eurostat, employment and unemployment rates are used for all countries where available. US and Canadian data is from national statistics offices. Asian country data, where available, was gleaned from ADB (Asian Development Bank). Data for Latin American and Caribbean countries is from IADB (Inter-American Development Bank). Selected countries have been verified against World Bank data. The timeliness and detail of employment and unemployment data varies widely by country. The approach was to use the best available data for each country. ILO’s Eapep data base yields a 2008 estimate of the labor force for each country in the sample, and is used when other data is not available. In combination with employment levels from national, regional and multilateral sources, or Laborsta if not available, the unemployment rate can be calculated.

**Functional distribution of income:** Principally, wage shares are the total wage bill or employee compensation relative GDP at factor cost. Estimates of wage shares are often not readily available for developing countries due to the importance of informal activities. Ideally, employee compensation as well as GDP at factor cost collected for formal economic activities should be adjusted by estimates for informal economic activities. Since labor productivity in the latter tends to be very low, this would represent an upward adjustment of the wage share. Where data was not available, reasonable adjustments have been made. The wage shares are reported in Table 4. Data was collected from the following sources: (1) EUROPA – Economic and Financial Affairs – Indicators – AMECO database. The Ameco database calculates wage shares as compensation per employee relative to GDP at factor cost per employee. The Ameco data is the basis for wage share estimates with a source denotation as “EU”; (2) ILO/IILS: Charpe, M. ‘All\_WS\_MC\_INST.xls’ (International Labour Organization and International Institute for Labour Studies, 2008). These wage shares have been adjusted by a factor to include the self-employed. In the table, wage shares from this source are denoted as “ILO.” (3) Rada (2010) and (4) Vasiliouk (2008).

**Import elasticities:** The trade structure requires price and income elasticities of import demand. See Table 5. The elasticities are either based on the author’s calculations or taken from the literature. Data is taken from IMF International Financial Statistics (IFS). Quarterly data was used in all countries except for Venezuela, Egypt, and Pakistan. We use *Import Volume* and *Gross Domestic Product Volume* indexed to 2005 for ease of comparison. For the price elasticity we calculated a relative price, if both the import price and GDP deflator were available. The relative price is calculated by using the implicit price deflator of imports divided by the implicit price deflator of domestic GDP. Where import prices were not available, the Real Effective Exchange Rate was used for the price elasticity calculation. This was also indexed to 2005 to provide continuity. Price and income elasticities are calculated using both a log-linear model and a first difference log-linear model. The primary log-linear model follows the classical paper by Houthakker and Magee (1969). The first difference model is a differenced version of the Houthakker-Magee model seen in much of the trade elasticity literature including Marquez (2002). The primary regression in both cases uses OLS methods to regress the logarithm of the volume of imports on the logarithm of both domestic GDP and the relative price. The data for each country was tested for stationarity using the augmented Dickey-Fuller test. The results were chosen based on their tests for stationarity and their statistical significance. In most cases data was used from 1990 to 2009 in all countries where the elasticity was self calculated. The exceptions to this date range were Morocco (1990 to 2008), South Africa (1990 to 2006), Brazil (1995-2009), and Argentina (1993-2009). For countries where data was unavailable or elasticity estimates were unreliable using conventional methods, the most recent papers from the trade elasticity literature were used. Using data from 1984 to 2003, Kwack et al. (referred to as KALY in table 5) use an OLS method for 30 countries using pooled cross country time series. The authors use a log linear model controlling for the geographical distance between the capital city of the importing country and the capital city of the exporting country. Ivanova (2007) uses a vector error correction model to adjust for cointegration and estimates long run elasticities for Russia.